

# **Success Stories in Software Reuse & UI Development**

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# Goals

- \* Starting Reuse early
- \* Effective UI development
- \* Rant



# Spot Development

- \* Started 1999
- \* Java Desktop Application
- \* Spitzer planning tools
- \* No re-use planed

# Spot

**Spot -- Spitzer Planning Observations Tool**

File Edit Targets Observation Tools Images Overlays Options Window Help

Mouse Control: Left Mouse Button: Move Focal Plane  
Shift-Left Button: Center the Image at point

Mouse: Spitzer Focal

**Configure Focal**

IRS | MIPS | IRAC | PCRS | Admin

☒ IRS

☒ Short Low (5.3 - 8.5) Color...

☒ Short Low (7.4 - 14.2) Color...

☒ Short high Color...

☒ Long Low (14.2 - 21.8) Color...

☒ Long Low (20.6 - 40.0) Color...

☒ Long high Color...

☒ IRS Peak-up (Red) Color...

☒ IRS Peak-up (Blue) Color...

Center:

Done Help

**Constrain Data - NED**

Data Field: unc\_major

Direction: Show Values between

Minimum: 0.120 10,000 150,000

Maximum: 0.120 10,000 150,000

Show unc\_major values between 5.7

Done Help

**List of Targets**

Target	Position	Equinox	Type
m51	13h29m52.37000...	Equatorial J2000	Fixed Single
Saturn Bary...	6		Moving Single
ngc17	0h11m06.55000...	Equatorial J2000	Fixed Single
m31	0h42m44.31000...	Equatorial J2000	Fixed Single
n1	0h07m15.84...+27...	Equatorial J2000	Fixed Cluster

Delete Modify Show Background Show Visibility

Done New Target Help

**m51 DSS Second Generation**

**m51 2MASS-K**

**NED-R, m51**

**ngc17 DSS Second Generation**

**NED Catalog**

Controls: Hide All Show All Names Color Save Table...

On	Hi	Shape	Tgt Name	Show Name	RA	Dec	type	unc_major	unc
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	MESSIER 051 [S7...	<input checked="" type="checkbox"/>	13h29m37.69999s	+47d08m43.0001s	HII	5.0	5.0
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	NGC 5194 [PHB9...	<input checked="" type="checkbox"/>	13h29m39.43001s	+47d08m29.5001s	HII	1.75	1.75
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	NGC 5194 [PHB9...	<input checked="" type="checkbox"/>	13h29m41.02001s	+47d08m16.1999s	HII	1.75	1.75
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	CXDM51 J133006...	<input checked="" type="checkbox"/>	13h30m06.46999s	+47d08m38.3000s	X-Ray5	2.5	2.5
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	NGC 5194 [PHB9...	<input checked="" type="checkbox"/>	13h29m51.84001s	+47d07m44.4000s	HII	1.75	1.75
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	NGC 5194 [PHB9...	<input checked="" type="checkbox"/>	13h30m07.50000s	+47d08m39.9999s	X-Ray5	13.6999998	13.69
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	NGC 5194 [PHB9...	<input checked="" type="checkbox"/>	13h30m05.98999s	+47d14m55.2998s	HII	1.75	1.75
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	NGC 5194 [ICM6...	<input checked="" type="checkbox"/>	13h29m41.74999s	+47d08m07.5001s	HII	1.75	1.75
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	NGC 5194 [PHB9...	<input checked="" type="checkbox"/>	13h29m57.46001s	+47d07m46.4999s	HII	1.75	1.75
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	[ICHP2004] J1329...	<input checked="" type="checkbox"/>	13h29m37.90001s	+47d08m30.9998s	X-Ray5	5.0	5.0
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	NGC 5194 [PHB9...	<input checked="" type="checkbox"/>	13h29m50.80001s	+47d07m40.1002s	HII	1.75	1.75
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	CXDM51 J132943...	<input checked="" type="checkbox"/>	13h29m43.36001s	+47d15m25.3001s	X-Ray5	2.5	2.5
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	CXDM51 J133000...	<input checked="" type="checkbox"/>	13h30m00.61999s	+47d15m30.4999s	X-Ray5	2.5	2.5
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	NGC 5194 [PHB9...	<input checked="" type="checkbox"/>	13h29m42.07001s	+47d07m58.6999s	HII	1.75	1.75
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	CXDM51 J132936...	<input checked="" type="checkbox"/>	13h29m36.76999s	+47d14m48.5002s	X-Ray5	2.5	2.5
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	NGC 5194 [PHB9...	<input checked="" type="checkbox"/>	13h29m53.44999s	+47d07m31.3000s	HII	1.75	1.75

Done Help

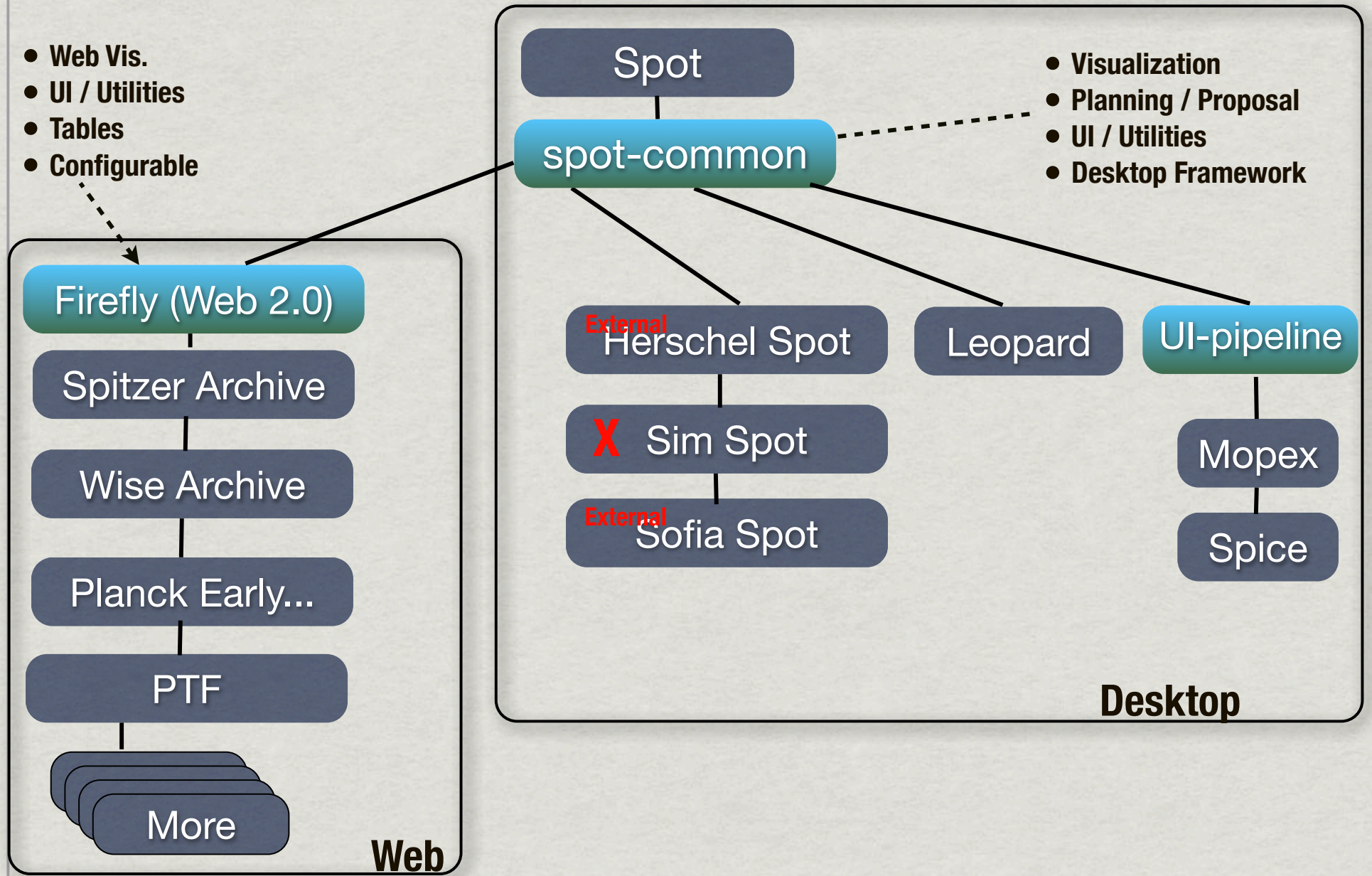
Proposal: <No File>



# Reuse History

- Web Vis.
- UI / Utilities
- Tables
- Configurable

- Visualization
- Planning / Proposal
- UI / Utilities
- Desktop Framework



# Challenges

Firefly (Web 2.0)

- \* Advanced tables for very large queries ← Hard
- \* Visualize FITS on the Web ← Never been done
- \* Interactive UI ← Ease of Use
- \* Easy data selection and download ←
- \* Configurable for multiple archives ← Reuse \$\$\$ Saver



# What is Firefly?

Firefly (Web 2.0)

- \* Web based / AJAX / GWT
- \* Framework for archive UI
- \* Highly integrated
- \* Web FITS visualization
- \* Spectrum visualization
- \* “Excel-like” table features
- \* Scalable
- \* User-friendly
- \* Configurable

# UI Features

Firefly (Web 2.0)

- \* Complexity hidden
- \* Field validation
- \* Iterative target lookups
- \* Backgrounding jobs
- \* Search histories
- \* Help, Tool tips
- \* Preferences
- \* Data packaging



# Advantages

Firefly (Web 2.0)

- \* Consistent Look & Feel
- \* Time Saver
- \* Cost Saver
- \* Less learning curve
- \* Focus on one development
- \* Synergy across projects

# Paging Scroll Table

Tabs

Sortable

Columns  
Resize

Filters

More  
Detail

The screenshot displays a web application interface for position search results. The main table lists observation requests with columns for AORKEY, Instrument/Mode, Bandpass, RA (J2000), Dec (J2000), File type, and File description. A red box highlights a portion of the table, and a 'Table Options' dialog is open, showing a list of columns and checkboxes for selection. A 'Details' panel on the right provides additional information for the selected row. Red arrows point to various features: 'Tabs' (Observation Requests (AOR) and Level 2 (PBCD)), 'Sortable' (RA and Dec columns), 'Columns Resize' (vertical line between columns), 'Filters' (Add filters button), 'More Detail' (Details panel), 'Paging' (1 of 25), 'Page Size' (Page Size: 50), 'Column Control' (Table Options dialog), and 'Fast Data Display' (Details panel).

AORKEY	Instrument/Mode	Bandpass	RA (J2000)	Dec (J2000)	File type	File description
12552192	IracMap	IRAC 8.0um	0h42m18.48s	+41d0m19.0s	Image	Mosaic image (long framerate if data taken in H
15214336	IracMap	IRAC 5.8um	0h43m18.00s	+41d25m6.6s	Image	
15214336	IracMap	IRAC 5.8um	0h43m29.89s	+41d20m43.2s	Image	
12552192	IracMap	IRAC 8.0um	0h42m33.79s	+41d4m18.9s	Image	
15214336	IracMap	IRAC 5.8um	0h42m54.10s	+41d25m25.5s	Image	
15214336	IracMap	IRAC 5.8um	0h42m28.70s	+41d26m3.4s	Image	
15214336	IracMap	IRAC 5.8um	0h43m4.25s	+41d21m15.3s	Image	
15213824	IracMap	IRAC 3.6um	0h42m32.12s	+41d5m24.8s	Image	
15214336	IracMap	IRAC 5.8um	0h42m14.81s	+41d22m10.5s	Image	
15214336	IracMap	IRAC 5.8um	0h42m30.87s	+41d5m36.3s	Image	
15214336	IracMap	IRAC 5.8um	0h42m38.63s	+41d21m34.9s	Image	
15214336	IracMap	IRAC 5.8um	0h43m14.23s	+41d17m9.6s	Image	
12550656	IracMap	IRAC 8.0um	0h42m55.02s	+41d1m17.3s	Image	
15213824	IracMap	IRAC 3.6um	0h42m24.88s	+41d17m34.9s	Image	
15214336	IracMap	IRAC 5.8um	0h41m59.37s	+41d18m14.8s	Image	

1 of 25 Page Size: 50

**Table Options**

Column	Show
Instrument/Mode	<input checked="" type="checkbox"/>
Bandpass	<input checked="" type="checkbox"/>
RA (J2000)	<input checked="" type="checkbox"/>
Dec (J2000)	<input checked="" type="checkbox"/>
File type	<input checked="" type="checkbox"/>
File name	<input type="checkbox"/>
File description	<input checked="" type="checkbox"/>
RA (J2000 deg)	<input type="checkbox"/>
Dec (J2000 deg)	<input type="checkbox"/>
Epoch	<input type="checkbox"/>
Equinox	<input checked="" type="checkbox"/>
Observation start	<input type="checkbox"/>

**Details**

Additional Information

Name	Value
AORKEY	12552192
Instrument/Mode	IracMap
Bandpass	IRAC 8.0um
RA (J2000)	0h42m18.48s
Dec (J2000)	+41d0m19.0s
File type	Image
File name	r12552192/ch4/pbcd/SPITZER_I4_12552192
File description	Mosaic image (long framerate if data taken in
RA (J2000 deg)	10.5770
Dec (J2000 deg)	41.0053
Epoch	2005.0561
Equinox	2000.0000
Observation start	2005-01-20 11:18:04
Observation end	2005-01-20 11:18:29
Min wavelength (microns)	6.4300

Paging

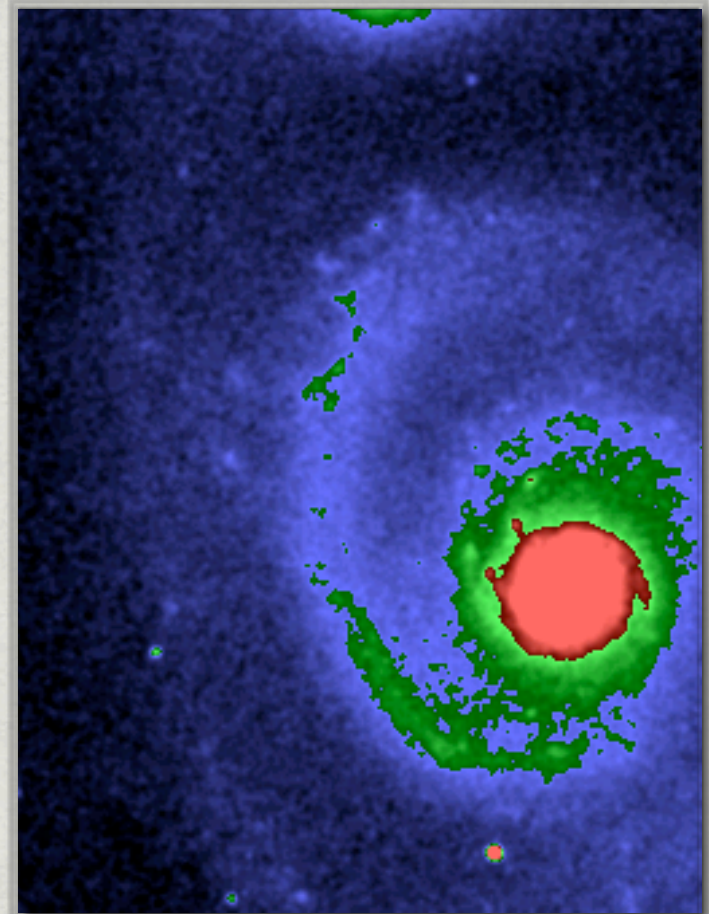
Page  
Size

Column  
Control

Fast Data  
Display



# Visualization





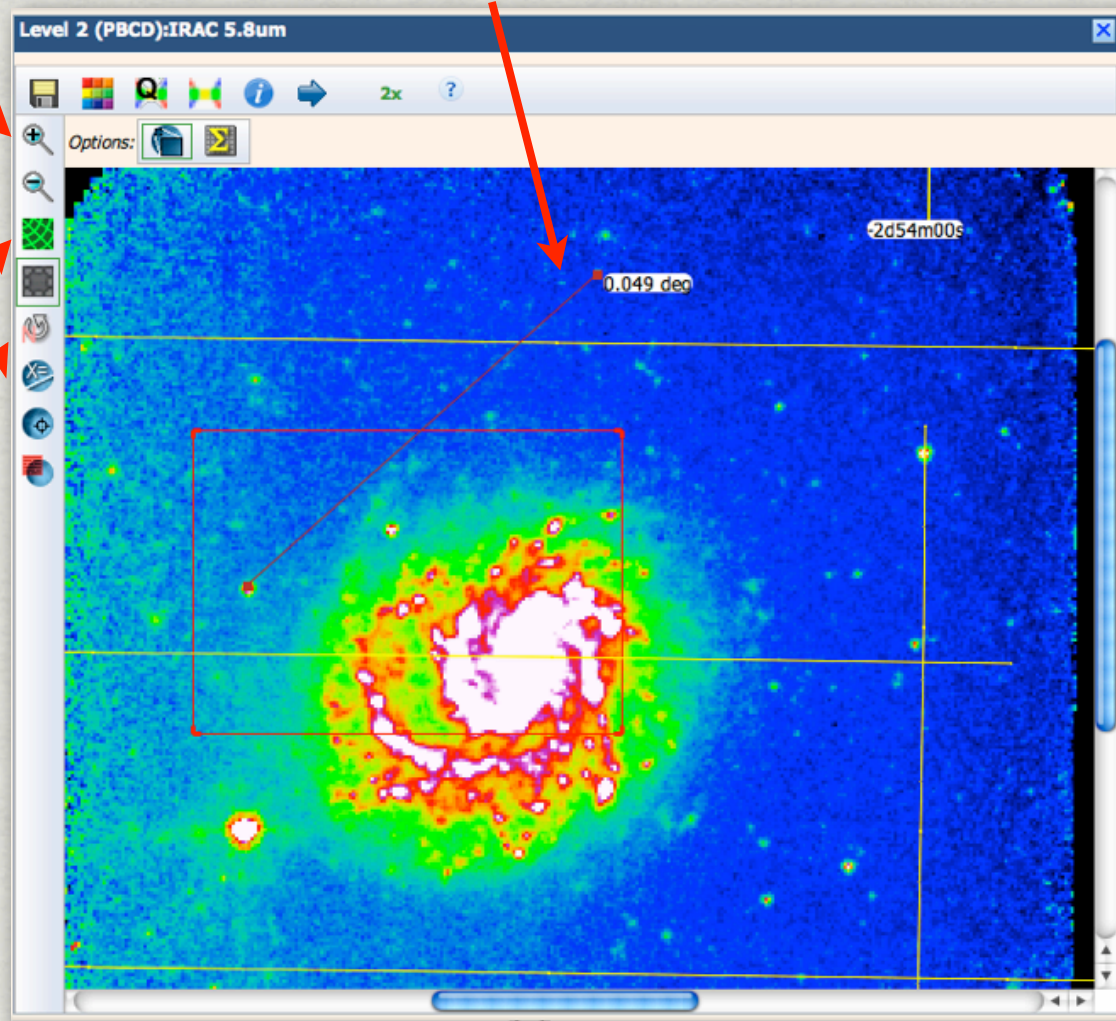
Zoom

Distance  
Tool

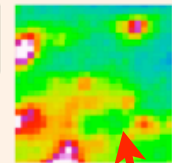
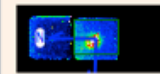
Readout

Grid

Rotate  
North



Eq-J2000: 4h41m25.07s, -2d51m52.3s  
Eq-J2000: 70.354, -2.865  
Image Pixel: 591, 274.5  
Gal: 199.558, -30.029  
Eq-B1950: 4h38m54.52s, -2d57m34.5s  
Flux: 1.777 MJy/sr  
1 Pixel: 1.2"



Magnifier

Thumbnail

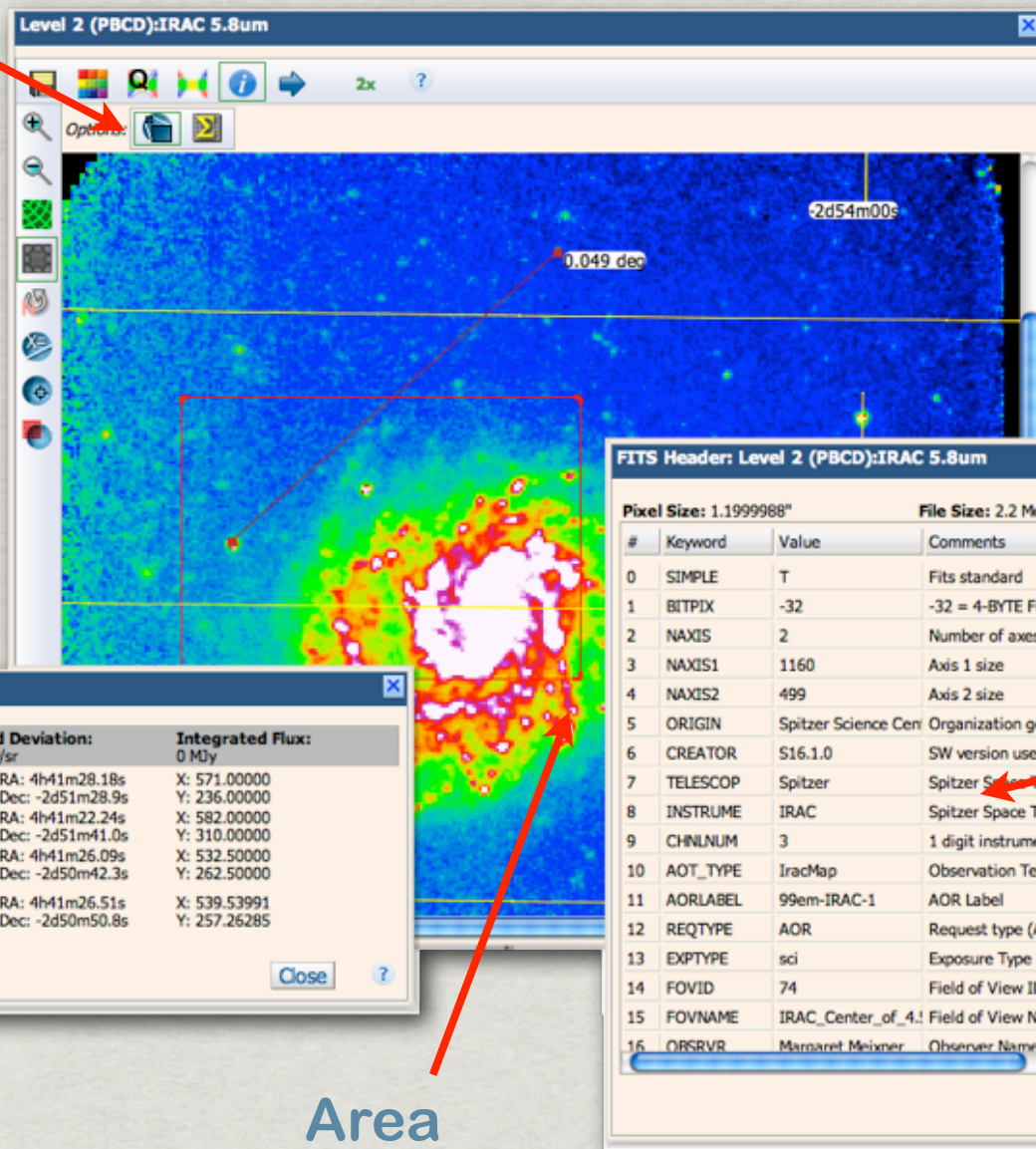


Crop

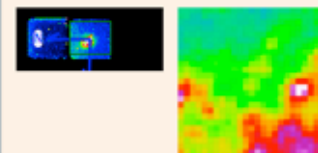
Image  
Statistics

Image Statistics		
Mean Flux:	Standard Deviation:	Integrated Flux:
1.776 MJy/sr	2.014 MJy/sr	0 MJy
Max Flux:	Eq-J2000 RA: 4h41m28.18s	X: 571.00000
124.958 MJy/sr	Eq-J2000 Dec: -2d51m28.9s	Y: 236.00000
Min Flux:	Eq-J2000 RA: 4h41m22.24s	X: 582.00000
1.258 MJy/sr	Eq-J2000 Dec: -2d51m41.0s	Y: 310.00000
Aperture	Eq-J2000 RA: 4h41m26.09s	X: 532.50000
Centroid:	Eq-J2000 Dec: -2d50m42.3s	Y: 262.50000
Flux	Eq-J2000 RA: 4h41m26.51s	X: 539.53991
Weighted	Eq-J2000 Dec: -2d50m50.8s	Y: 257.26285
Centroid:		

Area  
Selection

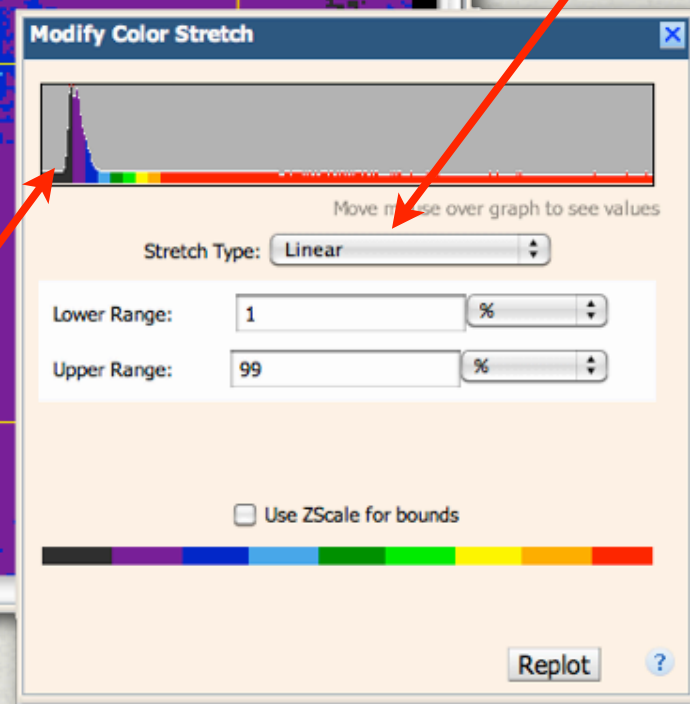
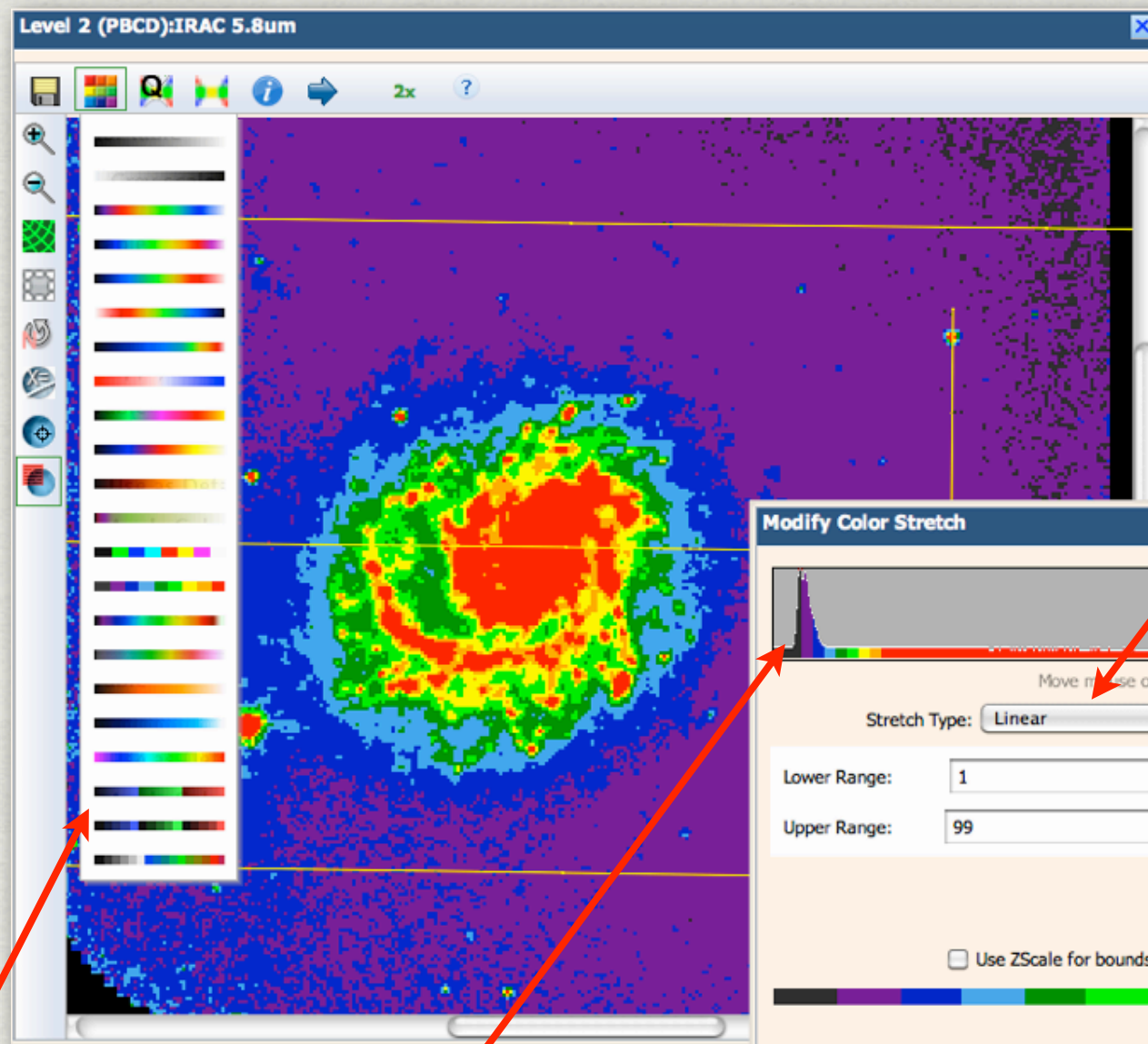


Eq-J2000: 4h41m25.71s, -2d51m06.8s  
Eq-J2000: 70.357, -2.852  
Image Pixel: 553, 267  
Gal: 199.547, -30.021  
Eq-B1950: 4h38m55.15s, -2d56m48.9s  
Flux: 1.721 MJy/sr  
1 Pixel: 1.2"



FITS Header: Level 2 (PBCD):IRAC 5.8um			
Pixel Size: 1.1999988"		File Size: 2.2 Megs	
#	Keyword	Value	Comments
0	SIMPLE	T	Fits standard
1	BITPIX	-32	-32 = 4-BYTE FLOAT, 16 = 2-BYTE INT
2	NAXIS	2	Number of axes
3	NAXIS1	1160	Axis 1 size
4	NAXIS2	499	Axis 2 size
5	ORIGIN	Spitzer Science Cen	Organization generating this FITS fi
6	CREATOR	S16.1.0	SW version used to create this FITS
7	TELESCOP	Spitzer	Spitzer Space Telescope
8	INSTRUME	IRAC	Spitzer Space Telescope instrument
9	CHNLRUM	3	1 digit instrument channel number
10	AOT_TYPE	IracMap	Observation Template Type
11	AORLABEL	99em-IRAC-1	AOR Label
12	REQTYPE	AOR	Request type (AOR, IER, or SER)
13	EXPTYPE	sci	Exposure Type
14	FOVID	74	Field of View ID for Commanded Po
15	FOVNAME	IRAC_Center_of_4.1	Field of View Name for Commanded
16	ORSRVR	Margaret Meixner	Observer Name (Last, First)

FITS  
Header  
Info





# Firefly Reuse Challenge



**SOFIA**

**IRAS**

**PLANK**

**SPITZER**

**2MASS**

**DENIS**

**MSX**

**PTF**

**WISE**

**LEGACY**

**BOLOCAM**

**IRTS**

**HERSCHEL**

Requirements: Moving Target

# It gets worse.....

## AJAX UI Web Development Is Hard

- \* Desktop-like UI
- \* Event oriented
- \* Asynchronous
- \* Multi-browser testing required
- \* Complex layout & interaction



# Configurable Interface

The diagram illustrates a configurable interface system. On the left is a screenshot of the 'Wide-Field Infrared Survey Explorer' application. The interface includes a sidebar with search criteria (Position, SearchFrame, Coord, Source ID, Solar System Object Orbit, Table Library), a main search area with input fields for Name or Position, Search Type (Region Intersection), Return Image Size, and Return only the most centered image containing the target. On the right is an XML configuration file named 'project.dtd'. The XML structure defines a project, search type, and form layout. A large grey arrow points from the XML file to the UI, indicating that the XML file configures the UI. Two red arrows point from the labels 'UI' and 'XML File' to their respective components.

UI

XML File

```
<!DOCTYPE Project SYSTEM ".../project.dtd">
<Project>
  <Name>Zmass</Name>
  <Title>The Two Microns All Sky Survey at IPAC</Title>
  <SearchType>
    <Name>test1</Name>
    <Title>Search 2MASS</Title>
    <Tooltip>XML version of the original Demo 2MASS</Tooltip>
    <Form>
      <FieldGroup align="left">
        <PreDefField id="targetPanel"/>
        <DEGREE units="arcsec">
          <Name>searchByPos.radius</Name>
          <Title>Radius</Title>
          <Default>500</Default>
        </DEGREE>
      </FieldGroup>
    </Form>
    <Query queryId="aorByPos"/>
    <Query queryId="pccdByPos"/>
    <Result>
      <Layout>
        <SplitPanel>
          <East layout="tab">
            <Table type="selectable">
              <DataSource queryId="aorByPos"/>
              <Name>aorByPos</Name>
              <Title>AOR Table</Title>
            </Table>
            <Table type="selectable">
              <DataSource queryId="pccdByPos"/>
              <Name>pccdByPos</Name>
              <Title>PCCD Table</Title>
            </Table>
          </East>
          <West>
            <Preview type="coverageViewer">
              <DataSource queryId="aorByPos"></DataSource>
            </Preview>
          </West>
        </SplitPanel>
      </Layout>
    </Result>
  </SearchType>
</Project>
```

# Each Component & Behavior Configurable

The screenshot displays the NASA/IPAC Infrared Science Archive (IRSA) website. The interface includes a top navigation bar with links like 'IRSA', 'Mission', 'Archive Search', 'Related Data Archives', 'Tools & Services', and 'Help'. Below this is a search bar and a 'Search Again' button. The main content area is divided into several sections:

- Tabs:** A tab labeled 'Coverage' is active, showing a '3 Color' preview of a celestial object.
- Tables:** A table titled 'Results' displays a list of astronomical objects with columns for 'Band', 'RA (deg)', 'Dec (deg)', and various coordinates. The table is scrollable and includes a 'Download Options' section.
- 3 Color Images:** Below the table, there are four preview images labeled 'Preview: WISE Band 1', 'Preview: WISE Band 2', 'Preview: WISE Band 3', and 'Preview: WISE Band 4'. Each image has a zoom control.
- Forms:** A 'Search By' form is visible on the left, with fields for 'Name or Position' and 'Search Type (Region Intersection)'. It also includes checkboxes for 'Return Image Size' and 'Return only the most recent images containing the target'.
- Standard Fits Images:** A 'Show Preview' button is located next to the band 4 image, which likely leads to standard fits images.
- Layout Position:** A red arrow points to the 'Layout' section of the 'Results' table, indicating the layout position of the data.
- Controls:** A red arrow points to the 'Zoom' control for the 'Preview: WISE Band 4' image, highlighting the interactive controls.



# Flexibility: Huge Benefits

- \* Separates Data services from UI
- \* Supports specific needs
- \* Very little code
- \* Sharing capabilities
- \* Consistent UI
- \* Cost savings
- \* Fast changes
- \* Quick development
- \* End user focus
- \* Synergy
  - ➔ Testing
  - ➔ Features
  - ➔ Support

# UI Conclusions

- \* UI need to be considered important
- \* Need a senior developer / visionary
  - ➔ Error 1 : hire junior developer and leave him alone
  - ➔ Error 2: Scientist with out strong CS skills
- \* Lots of skill out there



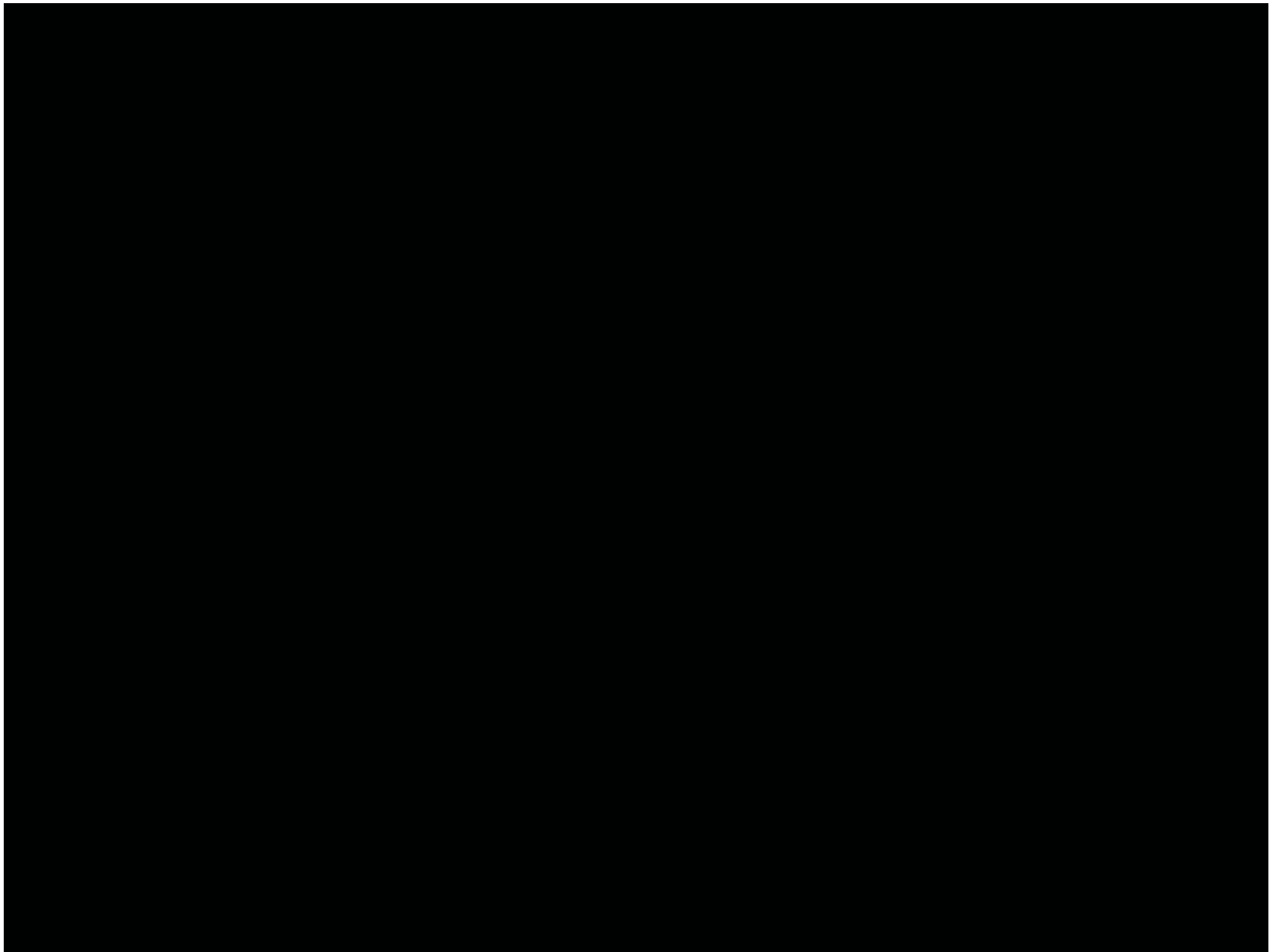
# Reuse - Conclusions

1. Think about reuse from day 1
2. Use simple software engineering
3. Mix CS people & Science developers
4. Train Object Oriented
5. Team development

# Rant

- \* Many large data set issues are software issues
- \* Quality software necessary for large data sets
- \* Quality software should be financed
- \* Long slow change but must start





# Appendix



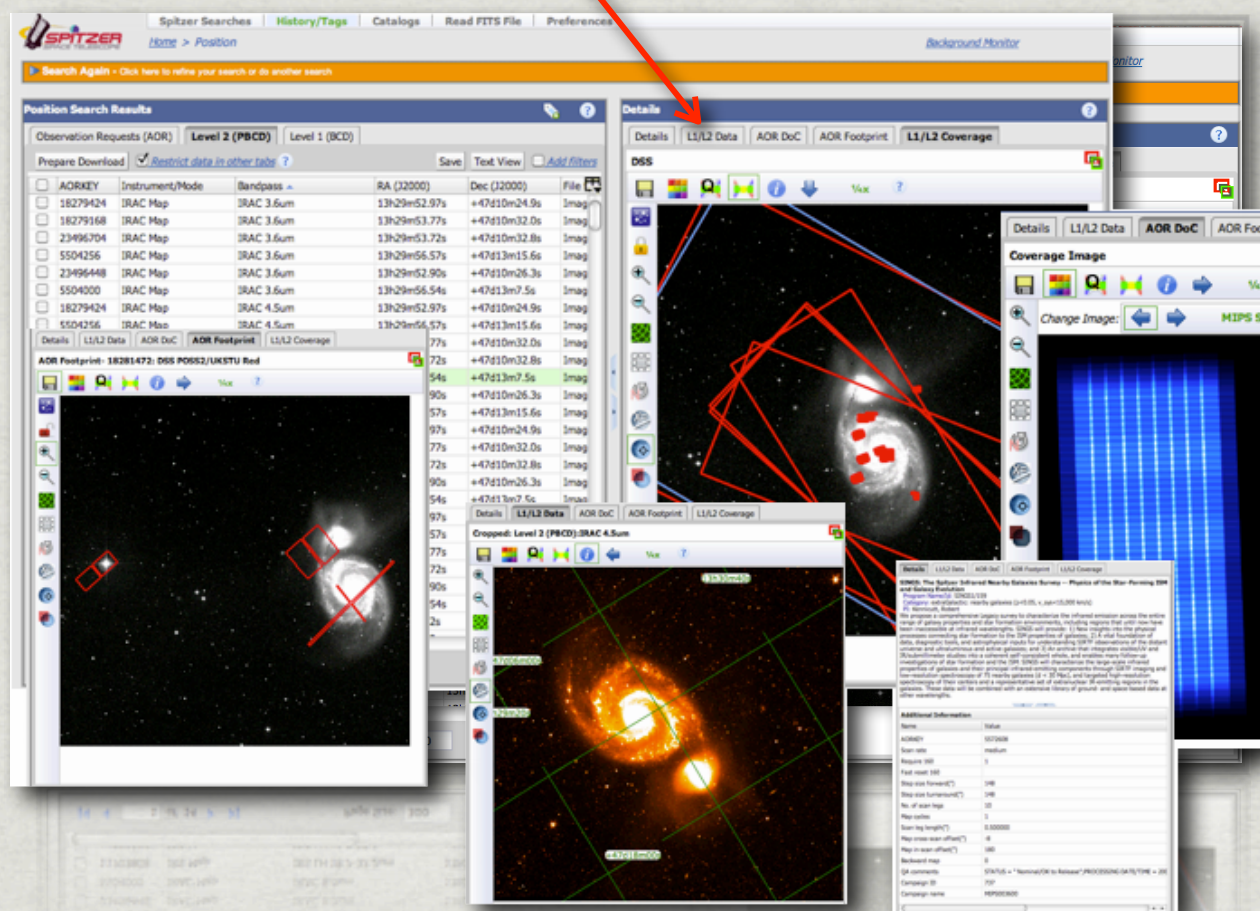
*Use: Spitzer Heritage Archive*

# Many displays behind tabs

Released:

- \* V1: Dec 2009
- \* V1.5: June 2010
- \* V2: March 2011

# 1-2 TB / Week





# Use: Planck Early Release Catalog

Released:

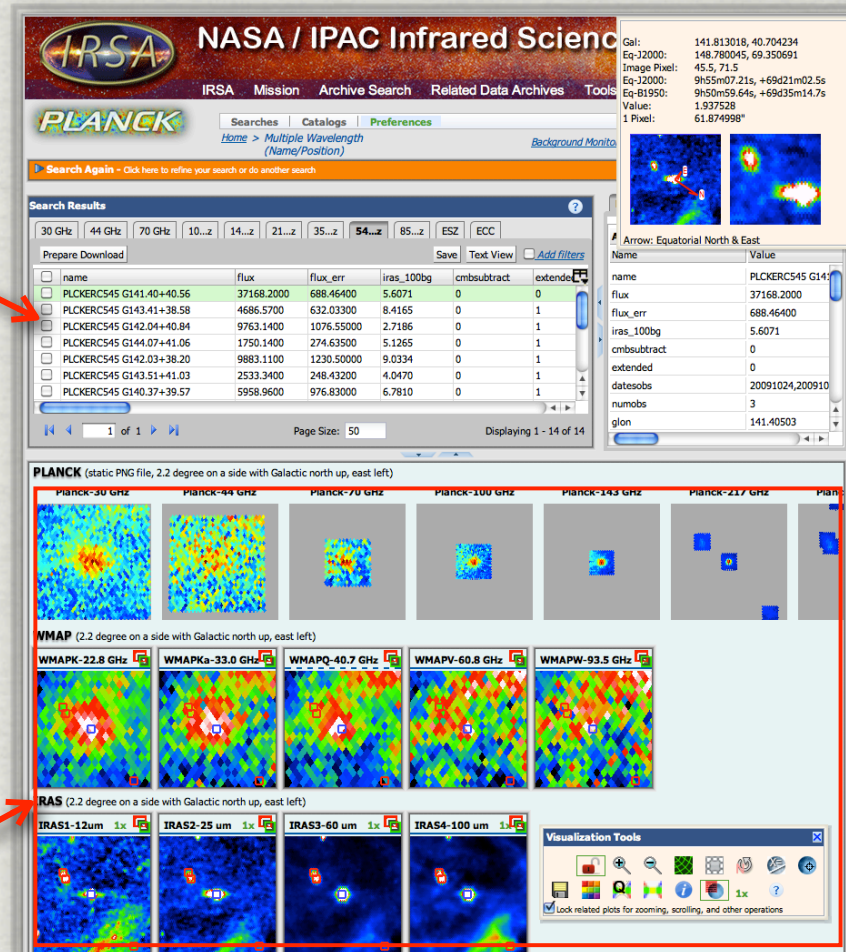
✱ V1: January 2011

ESA mission with NASA participation

Multi-image analysis

Click Here

All Change





# Use: WISE Image Archive

Released:

✱ V1: April 15, 2011

4 Images, plus 3 color

142 TB this year

260 TB next year

All move together

